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The Role of Navy METOC Regional Centers and Facilities in the New Millennium: Thoughts from a Sabbatical Tour

by

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During FY00, Professors Wash and Rosenfeld of the Naval Postgraduate School's Meteorology and Oceanography Departments, respectively, made extended visits to each of the Naval Meteorology and Oceanography Command's regional centers and facilities for the purposes of providing training, evaluating the use of METOC data, models, and tactical decision aids, and gathering information to aid in the improvement of the METOC curricula at NPS. This report represents a synopsis of their findings integrated over all of their visits.

Three major roles for METOC regional centers and facilities are identified: *i)* to be a source of local METOC knowledge and expertise for their area of responsibility, including familiarity with mesoscale circulations and all reliable sources of real-time data and model output; *ii)* to provide operational support to the fleet, including customized fused products and littoral oceanography products; and iii) to provide training for METOC personnel in regional-specific meteorology and oceanography, and continuing advanced technical training.

A major finding is that technical education and training is inadequate to allow METOC personnel to take maximum advantage of the full range of data, models, and tactical decision aids available to them. Weaknesses in the quality-control and verification of METOC analysis and forecast products are also identified. A number of innovative practices at individual commands are recommended for adoption throughout the claimancy.

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The Role of Navy METOC Regional Centers and Facilities in the New Millennium: Thoughts from a Sabbatical Tour

by
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I. Introduction

During FY00 we had the unique opportunity to visit all the U.S. Navy Commander, Naval Meteorology and Oceanography Command (CNMOC) regional centers and facilities for lengths of time ranging from one to six weeks, with the exception of a shorter visit to Pensacola during early FY01. During these extended stays, we made short visits to nearby ships and detachments, and also to universities for the purpose of fostering communication and collaboration. We also visited the CNMOC production centers, the Fleet Numerical Meteorology and Oceanography Command (FNMOC) and the Naval Oceanographic Office (NAVO). Also included in the sabbatical were stops at related organizations including Office of Naval Research (ONR, Arlington, VA and London), Naval Research Laboratory (NRL, Monterey and Stennis Space Center), Space and Naval Warfare Systems Command (SPAWAR), various operational NOAA offices; European Center for Medium-Range Weather Forecasting (ECMWF), the British Navy's Fleet Weather/Oceanography Center, the schoolhouse for enlisted aerographers' (AG) training at Keesler Air Force Base, and the Basic Officer Assession Training (BOAT) school in Gulfport. Our itinerary is attached as Appendix A.

During the extended visits to the regional centers and facilities we were able to observe, and participate in, activities carried out in support of routine operations, fleet exercises, and actual missions. We went through the meteorology and oceanography (METOC) products on each command's classified and unclassified web sites, observed how all analysis and forecast products were prepared, and asked a lot of questions. We spent time on the watch floor and with the Mobile Environmental Teams (MET). We worked most extensively with watch sections, Operations Officers, Fleet or Ocean Services personnel, the civilian Science and Technology Officers (STOs), and the Naval Oceanographic Office (NAVO) fleet representatives. As a result of our experiences, we have formulated some viewpoints about what is, and is not, working well at these centers, and have some suggestions for improvements.

METOC personnel are expected to be experts on a broad range of subject matter including: meteorology, physical oceanography, marine charting and geodesy, aspects of marine biology and geology, dispersion of hazardous materials and weapons of mass destruction, as well as military topics including history, weapons, ship operations, etc. Our comments here will only address the METOC areas of responsibility, but we are aware that they comprise but a fraction of the METOC personnel's duties.

The meteorology and oceanography needed by the Navy today is not the same as it was 10 to 20 years ago. Local observations and synoptic analysis are no longer a justification for existence of the regional centers. The centers' customers have increasing access to

non-Navy products via the internet. If the centers are going to stay relevant they need to provide products and advice that their customers can't get elsewhere and get feedback from their customers on the quality of their support.

In this report we will discuss what we perceive to be the primary roles Navy METOC regional centers and facilities should fulfill during the coming decade in supporting modern mesoscale meteorology and littoral oceanography, in addition to their more traditional roles in synoptic meteorology and blue-water oceanography. We have organized our comments to address the roles played by the centers and facilities in terms of local knowledge and expertise, operational support, training, and interaction between regional and production centers. Although we refer to METOC centers and facilities together in this report, we recognize that the facilities have narrower responsibilities and fewer resources, and our recommendations would have to be scaled down accordingly.

II. The role of regional centers/facilities as the source of local knowledge/expertise

An important role of regional centers/facilities is to be a source of local knowledge and expertise for the center's/facility's area of responsibility (AOR). In the past, this local knowledge often described larger-scale meteorological and oceanographic circulations and consisted of storm tracks and ocean basin climatology, including major currents. With the rapid advances in mesoscale meteorology and littoral oceanography, including new observational capabilities, theory and modeling, a center's local knowledge and expertise in the new millennium must include detailed knowledge of mesoscale phenomena in the atmosphere and the ocean for the AOR.

Examples of local knowledge for meteorology would include detailed knowledge of sea breeze behavior (timing of sea breeze front, penetration inland, extent over coastal waters) and influences of local topography on winds, precipitation and cloud systems. Littoral oceanography examples include known local upwelling centers, semi-permanent eddies, internal tide "hot spots", mesoscale ocean fronts, and local wave and water-level models. Presently, forecaster handbooks cover very little oceanography, usually only the major ocean currents. The meteorology component of the forecaster handbooks can be improved by including examples of detailed mesoscale meteorology of the AOR using high-resolution imagery from local Naval Satellite Data System (NSDS-E, now called FMQ-17) and Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) model analyses and forecasts. Forecaster handbooks should be updated frequently and made available on the command's web site.

One good way a center can improve its local knowledge/expertise is to interface with local experts at universities, civilian government laboratories, and allied militaries. An excellent example of one of these relationships, that is already well established, is the Naval Pacific METOC Facility (NPMOF)-Whidbey Island interaction with Professor Cliff Mass at the University of Washington, focussed on regional mesoscale analysis and forecasting. During the sabbatical, we were able to facilitate other such interactions, including linking Naval European METOC Center (NEMOC)-Rota, Spain with physical oceanographers at the University of Cadiz studying internal tide activity near the Straits

of Gibraltar and other local circulations. These external collaborators are a valuable resource. They can assist with activities such as review of training materials and forecaster handbooks, and provide knowledge of real-time data sources and models, and local phenomena in the atmosphere and ocean.

Another important part of local knowledge is familiarity with ***all*** near real-time data and model products for the AOR. There has been a spectacular growth in continuous measurement systems and coastal models for the atmosphere and ocean. The METOC regional centers should be the source that Navy users go to for all reliable METOC data for the AOR. The use by Naval Pacific METOC Center (NPMOC)-Yokosuka of a fronts and eddies analysis product for the Western Pacific from the Japanese Hydrographic Dept. is one example of this type of activity. While we were at NEMOC-Rota, we found a real-time buoy network and storm surge model run by the Spanish hydrographic office. These type of data and models, if found to be reliable after evaluation, should be utilized to complement existing capabilities and enhance the center service to the fleet.

Centers should develop case studies to illustrate important mesoscale phenomena in the AOR. These can serve as training examples and be used to familiarize new personnel with the METOC of the region. Another source of local knowledge is the post-deployment reports and exercise reviews for operations in the AOR. The center/facility should collect and maintain a repository of these reports. This would complement a library of appropriate papers, technical reports, charts, and up-to-date references on important phenomena and forecasting methods for the AOR.

METOC commands focus on effects of the environment on operations - ships, submarines, aircraft, and weapons. There is also a need for METOC personnel to think about the effect of operations on the environment - sound-focussing, marine mammals, air and water pollution. Examples that came up during our visits that possibly were attributable to Naval activity included cracked windows and swimming pools incurred during practice bombing runs, and whale beachings during Naval exercises. Some of the knowledge required to address these issues may be outside the typical METOC officer's and/or AG sailor's education and training. This further emphasizes the need of the center to cultivate a variety of other experts that can help them properly serve the fleet.

Much of the new knowledge of the AOR comes from remote sensing systems. The capability to receive and display various types of satellite data has greatly improved with the addition of the NSDS-E systems at all of the centers. We urge the centers to explore the capabilities of new ocean and atmospheric remote sensing systems (satellite and surface-based) to better address their customers' needs. Examples of this that we saw on the sabbatical include the display of SeaWifs true color imagery at NEMOC-Rota, and the use of Quikscat scatterometer data at Naval Atlantic METOC Center (NLMOC)-Norfolk to validate wind warnings. Examples of other existing capabilities to be exploited include multi-channel low-cloud fog display to monitor sea fog at night, and cloud and water-vapor drift winds to provide near-real-time wind analyses for low and upper levels over the ocean.

A major challenge for the METOC centers and facilities is to maintain the METOC institutional memory for the AOR. The constant rotation of officers and AGs makes this task difficult. The STO and civilians must play an important role in maintaining the critical METOC knowledge of the AOR. This knowledge must expand to include more local METOC phenomena and effective use of new models and displays.

III. The role of regional centers/facilities for operational support

An active dialog with the fleet through fleet liaison and MET activities is essential to future center and facility development. Direct contact with ships, subs, aircraft, special operations units, etc. through fleet liaison allows explanation of products and is a conduit for customer feedback. Fleet liaison and MET activities also allow METOC personnel to become familiar enough with customer needs to suggest new products/services. Knowledge of the needs of the customers and customer feedback are critical to improve current services and guide development of new products. This dialogue will aid the centers/facilities in prioritizing customers' needs and eliminating obsolete products. Centers and facilities must always look for ways to automate products, thus saving command energy and time for new product development.

We found that the number and wide range of forecast products now available on the internet can overwhelm forecasters. Although the internet provides access to an ever increasing number of model and data displays, forecasters are faced with information overload and have difficulties managing the many sources of forecast information. Procedures are needed to guide the forecasters to make optimal use of their limited time in analyzing the current METOC problems and developing forecast solutions.

Efforts to address this issue include development of forecaster guidance and procedures, in the form of a tool kit (NEMOC-Rota, NPMOF-Whidbey Island), following proven forecast methods (FNMOC, 2000), and development of fused nowcast and forecast products. One example of a valuable fused product, created by NLMOC-Norfolk using the Weather Services Inc. (WSI) software, is the joining of satellite imagery and Naval Operational Global Atmospheric Prediction System (NOGAPS) forecasts over the North Atlantic Ocean (Figure 1). Another product, created by NPMOC-Pearl Harbor using the Joint METOC Viewer (JMV), fuses frontal positions and high seas warnings (from NPMOC-San Diego and NPMOC-Yokosuka) with current satellite imagery, providing an excellent Pacific Basin overview and briefing product (Figure 2).

On our sabbatical visits, we were surprised at the differences among the centers in the basin-wide synoptic products in terms of forecast valid time, appearance, and forecast variables. This must be a source of confusion when operating units move from one AOR to another. The claimancy should work towards a common look and feel to these products, especially within the same ocean. This task should become easier as more automated and fused products are utilized to characterize the synoptic scale features over the ocean basin. We also feel that more commonality, not necessarily uniformity, to the center websites would make it easier for the fleet customers to find the information they need.

During the course of the sabbatical year, we saw increasing use of COAMPS and Distributed Atmospheric Mesoscale Prediction System (DAMPS) by the centers. Navy mesoscale modeling (either COAMPS from FNMOC or on-site DAMPS) is a powerful tool allowing the center to forecast local circulations and weather significant to operations. It is challenging to interpret the high temporal and spatial resolution of mesoscale models and properly use the output for on-scene support. This emphasizes the need to develop sophisticated local knowledge, to determine what is real and what is spurious, and the need for mesoscale satellite and model training.

Often quality-control procedures, verification of products, and metrics to measure impact of the METOC forecasts were missing. It is critical that the centers/facilities quality-control all of their products, and those they are passing on from the production centers, and make sure the products are understandable to the user. In particular, it is very important to properly label all variables and the units they are expressed in. We saw instances where fields were pulled in from NAVO, a graphical display generated, a title misidentifying the variable added, and then the product was posted on the center's web site. We also saw an example where the variable identification and units were stripped when one production center reformatted a product from the other production center, and when transmitted to the regional center, the field was misinterpreted leading to generation of an erroneous product. However, we also saw efforts such as those in NPMOC-Pearl Harbor to coordinate and quality-control output from overlapping Modular Ocean Data Assimilation System (MODAS) domains.

Verification is a key component of forecaster training. Forecasters learn from feedback and evaluation of previous forecasts. Procedures to do this, unfortunately, are not in place at many centers. Some suggestions for implementing a meteorological forecast verification scheme were provided to the centers during the sabbatical.

Presently, results from ocean analysis, circulation, and tide models are examined only sporadically and by a very limited set of people. To gain familiarity with these important tools, wider exposure is needed. Some suggestions to accomplish this are to cross-train several individuals in the Operations and MET divisions on the use of these models, include them at the regularly scheduled Commanding Officer's (CO) briefs, and include them in training programs.

We saw a number of exciting METOC innovations for the new millenium, including:

1. displays of SeaWifs ocean color and other new satellite data (NEMOC-Rota)
2. graphical weather forecast (WEAX) products (NEMOC-Rota)
3. weather kiosk and automated flight briefer (NLMOF-Jacksonville and Naval Training METOC Facility (NTMOF)-Pensacola)
4. METOC scroller (NEMOF-Naples)
5. Target Area Meteorology (NPMOF-Pearl Harbor)
6. the use of COAMPS to improve mesoscale forecasting (NPMOC-San Diego, NLMOC-Norfolk and NEMOC-Rota)
7. the standup of a MET for mine warfare support at NTMOF-Pensacola

8. modern watch floor design using wall-mounted large flat screen displays for continuous monitoring of the AOR (NEMOC-Rota)
9. planning for netcentric operations (NLMOC-Norfolk and NPMOC-San Diego). We saw the seeds of netcentric operability in the support provided by NEMOC-Rota during the Kursk operations, when NLMOC's Distributed Atmospheric Mesoscale Prediction System (DAMPS) was down due to the transition from the classified to the unclassified side.

However, we recommend centers/facilities do not innovate at the expense of doing a good job on the basics: local knowledge of the AOR, tactically relevant products, and training.

We close this operations section with some observations on procedures and methods. The practice of having all day workers stand watch periodically pays dividends in training, morale and product quality-control. We understand all of the major centers are now following this approach. Forward-deployed Mobile Environmental Teams allow for rapid response by METOC personnel with local knowledge. The experiences of the MET team, when shared with the entire command, strengthen the command's knowledge of the local meteorology and oceanography of the AOR. Within this local knowledge are the seeds of new mesoscale products that can better serve the fleet.

Internet Relay Chat (IRC) is a powerful tool to coordinate forecast products. It provides direct communication between the numbered fleet METOC officers, the centers/facilities, and OA divisions afloat. We saw the IRC being effectively used between the Seventh Fleet METOC Officer and the center in Yokosuka. Knowledge of fleet operations and concerns, and of the current METOC situation and forecast reasoning, were exchanged. Exploiting methods which use minimal bandwidth, such as NWS' VISITVIEW, to focus the METOC discussions on center nowcast and forecast graphics can make IRC even more effective.

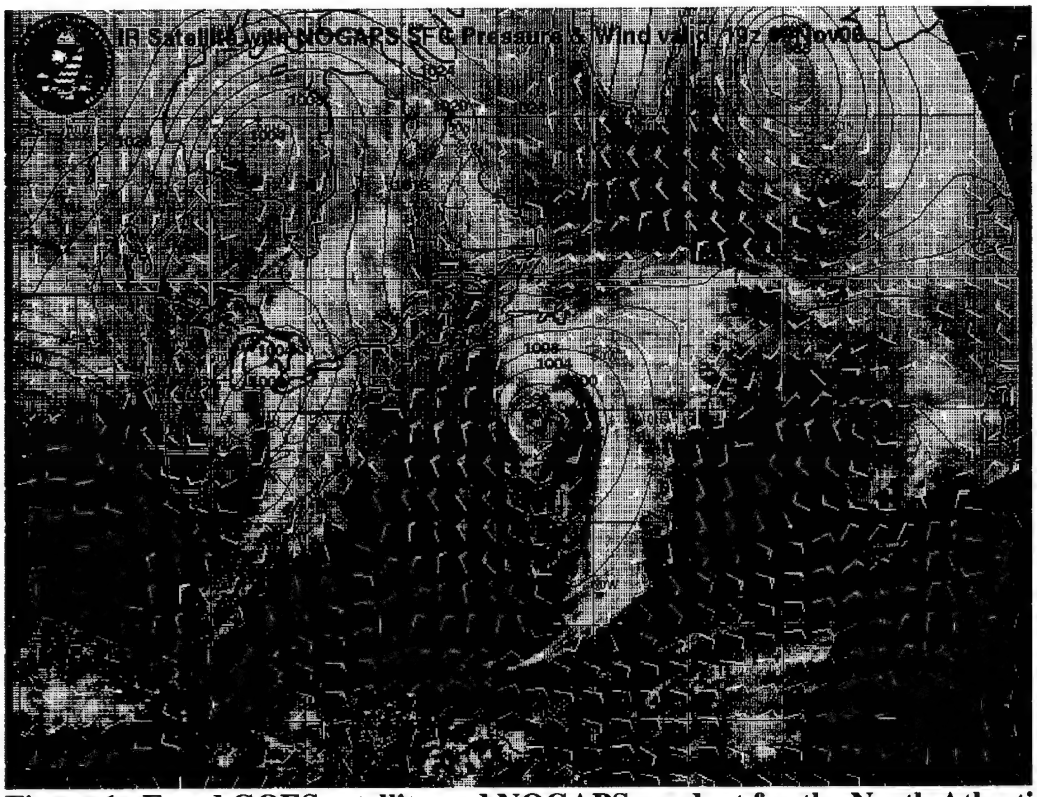

Figure 1. Fused GOES satellite and NOGAPS product for the North Atlantic Ocean, 1900 UT, 09 November 2000, produced by NLMOC-Norfolk using WSI software.

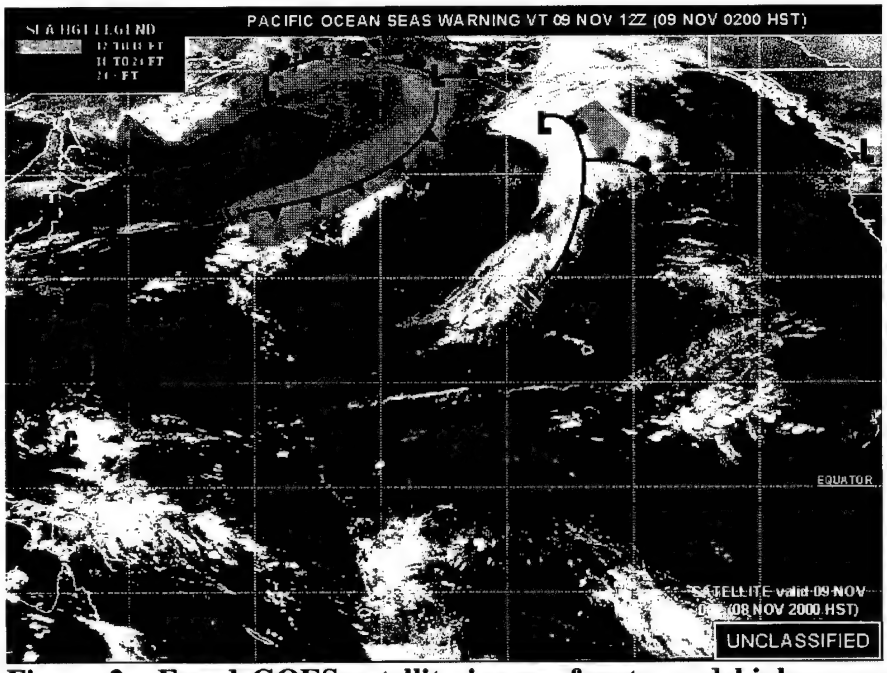

Figure 2. Fused GOES satellite image, fronts, and high seas warnings for North Pacific Ocean, 08 November 2000. Produced with JMV by NPMOC-Pearl Harbor using input from NPMOC-San Diego and Yokosuka.

IV. The role of regional centers/facilities in training.

A major finding of this study is that technical education and training is inadequate to allow METOC personnel to take maximum advantage of the full range of data, models, and TDAs available to them. This results in the under-utilization of METOC assets and systems, such as the NSDS-E, DAMPS, and ocean circulation models.

While education in the basics must take place at A and C schools, BOAT, and NPS, regional-specific knowledge, including mesoscale circulations, must be taught at the centers and facilities. There is no formal technical education after C school for the AGs and NPS for the officers, yet new developments, theory and applications need to be introduced throughout people's careers. If new forecast approaches are to be implemented on the watch floor, it is essential that the centers play a role in training. The current trend towards implementing sophisticated numerical models (DAMPS, MODAS, POM (Princeton Ocean Model), SWAN (Simulating Waves Nearshore)) at the regional centers underscores the need for a robust advanced training program.

Presently, oceanography training is primarily focussed on acoustics, but METOC personnel are asked to support a large range of operations including amphibious and mine warfare. Consequently, topics such as ocean tide and circulation models, new satellite products, and aspects of optical oceanography should be covered.

Centers/facilities must also educate their customers. This training fosters more effective dialogue and aids in the development of more relevant products for the users. In addition, METOC centers should be hubs for training for other METOC personnel in the area from detachments, OA divisions, and staffs. Chiefs and officers should attend group training both to set an example and provide feedback and quality-control. Training must be available to the watchstanders, as well as the dayworkers. For training on the watch to be effective, the Command Duty Officer (CDO) needs to play a leadership role. Universally, we found the attitude of the CDO had an important influence on the success of the training.

If scheduled at a time convenient for the watch section, it should be possible to accomplish at least 20-40 minutes of training during most watches. This training can take the form of one-on-one tutoring, a lecture, group discussion and/or self-study using CDs, the internet, books, or other materials. We found the watch changeover not to be a particularly effective time for training.

We recommend that not all of the training for the "under instruction" people occur on the watch floor. For part of the time, bring together all the trainees from all watches and teach them new material. For example, schedule a session on a topic in the syllabus (e.g. forecasting frontal movement, forecasting fog, or locating the jet with satellite imagery) for all the UI AGs and junior officers. If manning allows, creation of a fifth watch section can permit focussed intensive training, such as we saw being used effectively by

NLMOF-Jacksonville. One very interesting approach to training was a training stand-down that we participated in at NEMOC-Rota.

Each center should have a formal plan for training, both as to scheduling and content. Content should be designed to improve personnel skills and make better command products. The training officer should determine the needed training at the command, develop a command training plan, obtain needed training material and expertise from Naval METOC Professional Development Center (NMOPDC) and other sources, execute the training plan and record training progress. Two examples of excellent training plans were in place at NPMOC-Pearl Harbor and NEMOC-Rota.

Training opportunities can be increased by:

1. Using the CO's brief and forecast discussion as a training opportunity. This was being done effectively at NPMOC-Yokosuka.
2. Coordinating training opportunities in MET and Operations divisions, such as is done at NEMOC-Rota and NPMOC-Pearl Harbor.
3. Providing the means (x-terms or workstations), the encouragement and the time for people to get experience with UNIX programs (MODAS, DAMPS) off the watch floor.
4. To the extent feasible, having command personnel participate in short courses and meetings, with subsequent feedback to the whole command.
5. Conducting training exercises in Ops and MET. Examples we saw included a hurricane exercise at NLMOC-Norfolk and a realistic amphibious MET exercise at NEMOC-Rota.
6. Presenting MET post-deployment briefs to the whole command.

Use the best available talent for training including officers, enlisted sailors, civilians and visitors, and give them adequate time to prepare. Involve the NPS grads more in planning and providing training. The STOs can assist in various aspects of the training activity. Invite local experts from outside the command to offer seminars, or even just to sit in on training offered by the command and participate in the discussion.

New material to be learned should be included in qualification and certification tests. Training progress should be tracked in a database. The best example of this we saw was at NEMOC-Rota. They used an Access database to track all of the training within the command. Training materials and experiences must be shared within the claimancy through the use of web sites. For example, NPMOC-Pearl Harbor hosts a collaborative training web site. The new NMOPDC will be able to assist the centers and facilities with this.

We were very impressed with the mentoring program in place at NEMOC-Rota. They established Professional Development Boards for every member of the command. There was an education and training plan in place for each officer and AG reflecting the interests of the sailor and needs of the command. This type of mentoring pays big dividends in command morale and in retaining valuable personnel.

The speed of change of the science and METOC applications for the Navy will not decrease. Education and training programs are critical for an effective CNMOC command. The centers and facilities have a major role in accomplishing the training goals for the continuing success of Navy METOC.

V. Interaction between regional and production centers

The internet provides access to a huge, and growing, number of meteorological, and a lesser number of oceanographic, sites both for the forecasters and their customers. It is a challenge to keep up with these, and sort out those that are useful from those that are not. Similarly, the number of Navy products is also increasing. CNMOC and its production centers must provide assistance in keeping METOC personnel current. Unfortunately, we found that in many instances the Navy products were actually diverging, not converging, thereby making it increasingly difficult for the METOC personnel to stay on top of the latest developments. There needs to be communication, not competition, among FNMOC, NAVO, and SPAWAR, in supporting the METOC community. One example we observed was the overlap in the surface wave products coming from FNMOC and NAVO. The exact same model was distributed under two different names, WAM (Wave Model) and SWAPS (Spectral Wave Prediction System), respectively, causing widespread confusion. The model output was delivered in two different formats, thumbnail files for use in the JMV coming from FNMOC, versus gif images coming from NAVO. While we realize that these products may be aimed at different users, and both formats may be necessary, better coordination could still be accomplished.

The length of time between when NAVO/FNMOC/SPAWAR makes a product/model/Tactical Decision Aid (TDA) available to the regional centers and fleet customers, and when the users are comfortable using it, is often longer than the life-cycle of the new product/model/TDA. The large number of acoustics TDAs is an example of this. Although some users had access to a number of these (including GFMPL, PC-IMAT, and SIIP), no one really understood how they related to each other, or when it would be advantageous to use one over another. The numerous versions of GFMPL provide another example. Different METOC centers and facilities are using different versions for a variety of reasons. In some cases, the newer versions do not include modules that were in the older version and are still needed. Since little or no training is provided with each new release, people may stick with the older version just because they are familiar with it, and its quirks. In other instances, the computer hardware available may not be adequate to efficiently run the newest software.

Regional centers should look at the FNMOC and NAVO products for their AORs on a regular basis and provide feedback to the production centers when they see a problem. If the regional centers/facilities don't understand a product coming from NAVO or FNMOC, either what it means, or how to use it, they should press the production center for an answer. Likewise, if they see illogical inconsistencies among products, or a product is too difficult or cumbersome to use, they should work with the production centers to improve it– or drop it if no one is using it as is and it can't be fixed.

We found the interaction between NAVO and the regional centers/facilities to be unclear. While some of NAVO's products, such as STOICS and SAILS, and certainly the databases, were familiar to all of the METOC centers; others, such as REACTS, were not. We saw situations where NAVO products were provided to fleet customers and the appropriate METOC center/facility was not aware of the product. Just because a product or model domain is requested by one customer, say mine warfare, doesn't mean it might not be useful for another, say amphibious warfare. As an example, we were present when a civilian player in an exercise wished aloud for surface wave information for the area. Unbeknownst to the METOC personnel on the scene, NAVO had initiated a WAM domain at the request of another player in the exercise. The regional centers/facilities should be familiar with all Navy METOC products for their AORs. The METOC centers should play an important role in distributing NAVO ocean products/models to the right customers, training customers on their use and interpretation, and providing needed quality-control.

VI. Conclusions

We were afforded a unique perspective during extended visits to all of the METOC centers and facilities, plus shorter visits to numerous other activities. We were able to observe, and participate in, activities carried out in support of routine operations, fleet exercises, and actual missions working with a number of talented and motivated METOC officers and AGs. This experience allowed us to learn firsthand the challenges of providing METOC guidance to Navy operations in the air, on land, and at sea.

A major finding of our sabbatical visits is that technical education and training is inadequate to allow METOC personnel to take maximum advantage of the full range of data, models, and TDAs available to them. This results in the underutilization of METOC assets and systems. We also identified weaknesses in the quality-control and verification of METOC analysis and forecast products. On the positive side, we found a number of exemplary practices employed at one or more commands that would be of widespread benefit throughout the CNMOC claimancy.

We see an important future role of METOC centers and facilities to be the source of local knowledge and expertise for their AOR. With the rapid advances in mesoscale meteorology and littoral oceanography, METOC centers/facilities have a new and more powerful set of data, models and tools to attack and solve Navy METOC problems.

The major impediments to excellence that we see are: the high turnover rate in personnel which makes it difficult to maintain an institutional memory; the difficulty in keeping training up to date, particularly for the enlisted personnel; taking maximum advantage of the officers' technical graduate education given how late it comes in their careers; and making profitable use of the very junior AGs who may have little technical or scientific education.

Reference

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Appendix A: Sabbatical itinerary for Wash and Rosenfeld for FY 2000

Week of: Month	Date	Location
October	4	Monterey, CA
	11	"
	18	San Diego, CA
	25	"
November	1	MS and LA: NAVO, CNMOC and AMS Conference
	8	Rosenfeld- NAVO; Wash – San Diego
	15	San Diego, CA
	22	"
	29	"
December	6	Monterey, CA: NPS, FNMOC
	13	Yokosuka, Japan
	20	"
	27	"
January	3	LEAVE
	10	Yokosuka, Japan
	17	"
	24	LEAVE
	31	Yokosuka, Japan
February	7	Pearl Harbor, Hawaii
	14	"
	21	Monterey, CA
	28	Bay St. Louis, MS: NAVO, CNMOC,
March	6	Gulfport and Biloxi, MS: BOAT, Keesler
	13	Jacksonville, FL
	20	"
	27	Norfolk, VA
April	3	"
	10	"
	17	"
	24	"
May	1	"
	8	Washington D.C.: ONR, NOAA, N096, Ice Center
	15	Washington D.C.: Naval Academy, Pax NAS
	22	Monterey, CA
	31	London, England: ECMWF, ONR, British Navy METOC Center
June	5	Bahrain
	12	"
	19	LEAVE
	26	Naples, Italy
July	3	LEAVE
	10	Rota, Spain
	17	"
	24	"
	31	"
August	7	"
	14	"
	21	"
	28	Monterey, CA
September	4	"
	11	Whidbey Is, WA
	18	"
	25	Seattle, WA: Univ. of WA; Sydney, B.C.: Eastern Pac. Ocean Conf.

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